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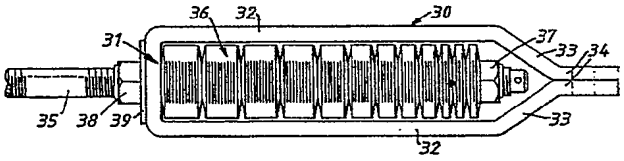
(54) Load setting and shock absorbing devices for tensionable lines.

(57) A device for facilitating the initial tensioning of a line comprises two relatively movable parts (35, 30) having resilient means (36, 45) acting therebetween, adjustable setting means (38, 46, 42, 43) for providing a preselected initial compression of the resilient means to set the amount of tension load needed to be applied across the device to initiate relative movement of the parts, and an indicator (39, 19, 44) responsive to that relative movement to indicate when that tension load has been reached. In one form the device functions also as a shock absorber with the resilient means (36, 45) being adapted to provide a progressively increasing resistance to axial extension of the device sufficient to effectively absorb shock loads applied in use. In another form the device functions as a turnbuckle having indicator devices (44) at each end thereof. The turnbuckle can also act as a shock absorber if required for particular applications.



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LOAD SETTING AND SHOCK ABSORBING DEVICES FOR TENSIONABLE LINES

FIELD AND BACKGROUND OF THE INVENTION

This invention relates to load setting and shock absorbing devices, and is concerned with such devices for setting predetermined tension loads applied to tensionable elongate elements, such as wire or rope lines. The invention also relates to devices for absorbing shock loads applied in use to such tensioned elongate elements.

There are many applications where it would be desirable to have an immediate indication of when a preselected tension loading is applied to a line during an initial tensioning thereof, in order to prevent overtensioning of the line, for example to show when a certain tension loading applied to a rigging line of a yacht is reached, or to indicate when a specified tension load is applied in a fixed ended safety support line, to which a person working at a height on a building can be attached, so that overloading of the end fixings of the line attached to the building or other fixed support structure does not occur during installation of the safety line. In the latter case, it is also desirable to provide a means for absorbing shock loads applied to the pretensioned safety line to restrain the fall of a person secured to the safety line.

U.S. Patents Nos. 3,918,301 and 3,033,154 disclose devices adapted to give a warning of when a predetermined tension is reached or exceeded in structures having parts which are relatively movable when subjected to loading. These devices include a stack or stacks of disc washers which act between relatively movable elements of the device and means actuated by a predetermined amount of relative movement of those elements to signal the occurrence thereof. These devices however are only adapted to function in the systems in which they are located, to provide an indication of when an overload condition occurs

during operation of the system.

British Patent Specification No. 2,130,737 discloses a device for indicating when an unacceptable reduction occurs in the tension of a clamping device, e.g. a vehicle wheel nut, and utilizes a flag member which is released to move under gravity or centrifugal forces to an indicating position when an unacceptable reduction in tension occurs.

SUMMARY OF THE INVENTION

An object of the invention is to provide a device, and a system incorporating a device, which is adapted to facilitate the presetting of an initial tension load in the system and preferably also thereafter to accommodate shock loads applied to the system.

The invention provides a shock absorber adapted to indicate when an initial acceptable tension specified for the installation of a safety line is reached, so that end attachments thereof to a fixed structure are not overloaded, comprising two relatively movable parts, resilient means acting between the parts to oppose relative movement thereof in a direction to effect axial expansion of the shock absorber when a tension loading is applied thereto by said safety line, adjustable setting means for applying an initial degree of compression loading to the resilient means for presetting the tension load required to be applied to the shock absorber to effect relative movement of said two parts in said direction, and indicator means responsive to said relative movement of the two parts to provide an indication of when said initial acceptable installation tension loading has been applied to the safety line, the shock absorber being adapted to allow a predetermined amount of relative movement of said parts after said indicator means have been actuated, and said resilient means being adapted to provide a progressively increasing resistance to said relative movement of said two parts to absorb shock loads applied in use to said safety line.

Said device may include a plurality of pairs of

relatively movable parts having respectively resilient means, setting means and indicator means as aforesaid whereby the setting means can be adjusted such that the respective indicator means are actuated at different values of applied tension loading. Similarly, two or more separate devices according to the invention preset to different actuating tension loadings, can be used in series to provide, for example, indications of a lower limit and an upper limit of an acceptable loading range.

In some arrangements according to the invention, two sets of said relatively movable parts may be provided and one part of each set may be provided by discrete portions of a body member of the device. The body member may be elongate with one relatively movable part slidably engaged with each opposite end portion of the body member. Said one relatively movable part at each end of the body member may comprise a tubular first member slidably, but non-rotatably, mounted with respect to the body member, and a second member screw-threadably received within the first member, the screw threads of the pairs of first and second members at respective ends of the body member being of the opposite hand.

The resilient means preferably comprise one or more disc springs which have predetermined load/deflection characteristics. It would be possible to use other types of spring for the resilient means but disc springs are likely to be more convenient for many applications.

The presetting means may comprise an abutment on each of said two relatively movable parts between which the resilient means act, and a manually adjustable element on one of the parts for moving that part relative to the other part to apply a selected degree of compression loading to the resilient means as aforesaid. In other arrangements, the presetting means may comprise an abutment on each of said parts between which the resilient means act, the abutment on one part being provided by a movable element on that part, the position of the element being

adjustable to allow the setting of a required amount of initial compression of the resilient means. Said element may be a screw-threaded element, e.g. a nut, located on a screw-threaded portion of the part with which it is associated.

The indicator means, which is normally responsive to commencement of said relative movement of said parts, may take various different forms. For example, it may comprise an element gripped between opposed portions of said parts until the tension load applied to the device reaches the pre-set tension load of the device, when the element is then released to indicate that the pre-set tension load has been reached.

The invention also provides a turnbuckle incorporating tension load indicating means, comprising an elongate, tubular body member, and, at each end thereof, a tubular first member slidably, but non-rotatably, mounted on the body member, a second member screw-threadably received within said first member, resilient means acting between said first member and the body member to oppose relative movement thereof in one direction when a tension loading is applied across the turnbuckle, adjustable setting means for applying an initial selected degree of compression loading to the resilient means for pre-setting the tension load required to be applied to the turnbuckle to effect relative movement of said first member and said body part in said one direction, and indicator means responsive to said relative movement to provide an indication of when tension loading applied to the turnbuckle, in use, reaches said preset tension load, wherein the screw-threads of the pairs of said first and second members at respective opposite ends of the body member are of the opposite hand whereby tensioning of a line associated with the turnbuckle can be achieved by rotating said body member about its longitudinal axis.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described by way of example, and with reference to the accompanying drawings, in which:-

Figures 1 and 2 are plan views of a shock absorber embodying the invention showing respectively a pre-set condition and a fully loaded condition thereof;

Figure 3 is a diagrammatic plan view of the shock absorber of Figs. 1 and 2 located in a safety line system;

Figures 4 and 5 are plan views of two alternative types of indicator element;

Figure 6 is an end view of an overload tag for use in the shock absorber of Figs. 1 and 2;

Figure 7 is a cross-section through the shock absorber with the tag of Fig. 6 disposed therein;

Figure 8 is a cross-section along line A-A in Fig. 7;

Figures 9 and 10 are, respectively , a side view and a vertical section through a further embodiment; and,

Figure 11 is a vertical section through a yet further embodiment.

DETAILED DESCRIPTION

Figures 1 and 2 of the drawings illustrate an embodiment of the invention in the form of a shock absorber. The device can be used for example in a safety line system which could be installed at a height on a building and to which workmen can attach themselves by means of lanyards which can be hooked onto the safety line. During installation of the safety line, it is desirable that the tension therein is not excessive so that undue strain is not applied to the wall fixing devices which secure the line. The device shown in Figures 1 and 2 not only provides a very convenient means of indicating when the predetermined safe installation tensioning of the wire has been reached but also provides a shock absorber for absorbing shock loads applied to the safety line when for example it is required to take the strain applied by the full weight of a workman.

The device comprises an elongate generally U-shaped frame 30 having a base part 31 and a pair of arms 32, the

free ends of which converge at 33 forming a pair of abutting flanges 34 having aligned apertures therein providing an attachment for the end of a safety line. The movable element 35 is in the form of a threaded rod which passes through the base 31 of the frame and extends between the arms 32 thereof. A stack of disc springs 36 is located on a portion of the rod lying between the arms 32 of the frame and a retaining nut 37 is provided on the threaded rod 35 to act on one end of the stack of the washers 36. A presetting nut 38 is provided on the portion of the rod 35 projecting from the frame 30 and an indicator element 39 is located between the nut 38 and the base 31 of the frame 30.

The indicator member 39 may have various different forms. It could be in the form of a simple washer. Figures 4 and 5 illustrate two other possible forms of the indicator member. In Figure 4, the indicator member 39 is in the form of a handwheel having a central aperture for receiving the threaded shank 13 and four projecting equi-angularly spaced lobes 21. Figure 5 shows another possible form of indicator member 19 which in this case is a flag 22 having an aperture 23 for locating the flag on the threaded shank 13.

As shown in Figure 3, the thread rod 35 is passed through an aperture in a fixed support 10 and secured therein by lock nuts 11. The safety wire 12 has a clevis device 13 secured at one end, which is fastened to the frame 30 by a pin 14 which passes through aligned apertures in the arms of the clevis and in the abutting flanges 34 of the frame 30. The clevis provides an entry device for engagement with the safety line 12 of an end connector of a lanyard of a safety harness, the end connector being in the form of a load transfer device of the type described in British Patent No. 1,582,201 or U.S. Patent No. 4,265,179, the disclosures of which are incorporated herein by reference. The use of such a load transfer device allows the lanyard end connector to pass any intermediate support points of the safety wire without being detached therefrom.

The nut 38 is adjusted so as to provide a specific

axial pre-compression of the stack of disc springs which is equivalent to the required tension loading applied across the device which will result in freeing of the indicator member 39 initially firmly gripped between the nut 38 and the frame 30. This amount of pre-compression can be readily calculated from the known load-extension characteristics of the stack of disc springs. In this way during installation of the safety line and during its initial tensioning, the shock absorber device gives a convenient indication when the specified installation tension is reached so that over-tensioning should not occur. Figure 1 illustrates the pre-set condition of the device with the indicator member 39 no longer firmly gripped between the nut 38 and the base of the frame 30. Under further loading conditions as illustrated in Figure 2, there is a progressive axial movement of the rod 35 against the action of the disc springs 36 as the load increases whereby shock loads applied to the safety line can be absorbed by the device. The number of, and indeed arrangement of, the disc washers are specifically selected to provide a progressive increase in the overall axial extension of the device as the applied load increases from the initial preset condition shown in Figure 1 so as to accommodate shock loading applied to the device in use after installation of the safety line system and the initial tensioning thereof. For example an initial preset load condition of the device could be equivalent to 115 kilograms and the device could allow a progressive extension of the device as the load increases up to 2050 kilograms which would then be equivalent to the maximum possible extension of the device as illustrated in Figure 2.

Figures 6 to 8 illustrate a plastically deformable, polycarbonate tag 15 having a pair of legs 16 which can be engaged between a pair of adjacent disc washers 36 of the shock absorber. The legs have detent projections 17 at their free ends to retain them in the frame of the shock absorber. When a shock load occurs and the stack of disc washers is compressed the material of the tag 15 plastically

extends under predetermined loads to give a permanent indication of a shock load of a particular magnitude having been applied.

Figures 9 and 10 illustrate a further embodiment in the form of a turnbuckle device for incorporation in a rigging line of a yacht to indicate the low limit and high limit of an acceptable range of tensioning thereof. The device comprises a tubular body member 40 having elongate cut-out portions 41 in opposite sides thereof. The device comprises a pair of load indicating means, one at each end of the tubular body 40, each load indicating means comprising an internally threaded sleeve 42 which extends through an aperture in a respective end wall of the body 40, the threads of the two sleeves 42 being of the opposite hand. Each sleeve has an annular end flange 43 which grips an indicator member 44 in the pre-set loaded condition of the indicator means. The indicator member 44 may be in the form illustrated in Figure 4 or in Figure 5. The sleeves 42 are radially keyed in their respective apertures in the end walls of the body 40 to prevent rotation of the sleeve with respect to the body. A pair of disc springs 45 is provided on the outer periphery of each sleeve 42 within the tubular body and a pre-set tensioning nut 46 is provided on a screw threaded outer peripheral portion of the sleeve 42 to effect a required degree of pre-compression of the stacked disc springs 45 in order to set the load required to actuate the respective indicator means. Threaded terminals 47 and 48 of the rigging lines are screwed into the respective sleeves 42. The rigging line is then tensioned by manually rotating the body member 40 until the device indicates that the tension loading is within an acceptable range.

The load indicating means at one end of the tubular body 40 is pre-set so that it is actuated at the lower limit of an acceptable tension range for the rigging line, for example 1000 kilograms while the load indicating means at the other end of the tubular body is pre-set so that it is

actuated at an upper limit of such a range, for example 1200 kilograms. In this way the rigging line can be tensioned until the lower limit value is indicated by the indicator means set to that value while the other indicator means will only be actuated when the load exceeds the upper limit of the acceptable range of tension in the rigging line.

A turnbuckle device as shown in Figures 9 and 10 can also be used in a safety line system as illustrated in Figure 3, in order to facilitate presetting of the initial tension of the line and thereafter to accommodate shock loads applied to the safety line. In such an arrangement the stack of disc washers 45 at each end of the device will be selected to give the required indication of an acceptable pretension loading applied to the safety line and also to give a progressive further axial extension of the device as the loading thereon increases in order to accommodate the aforesaid shock loads that may be applied to the safety line in use. This arrangement is illustrated in Figure 11.

CLAIMS:

1. A shock absorber adapted to indicate when an initial acceptable tension specified for the installation of a safety line, is reached so that end attachments thereof to a fixed structure are not overloaded, comprising two relatively movable parts, resilient means acting between the parts to oppose relative movement thereof in a direction to effect axial expansion of the shock absorber when a tension loading is applied thereto by said safety line, adjustable setting means for applying an initial degree of compression loading to the resilient means for presetting the tension load required to be applied to the shock absorber to effect relative movement of said two parts in said direction, and indicator means responsive to said relative movement of the two parts to provide an indication of when said initial acceptable installation tension loading has been applied to the safety line, the shock absorber being adapted to allow a predetermined amount of relative movement of said parts after said indicator means have been actuated, and said resilient means being adapted to provide a progressively increasing resistance to said relative movement of said two parts to absorb shock loads applied in use to said safety line.

2. A shock absorber according to Claim 1 wherein the resilient means comprise one or more disc springs which have predetermined load/deflection characteristics.

3. A shock absorber according to Claim 1 wherein the presetting means comprise an abutment on each of said two relatively movable parts between which the resilient means act, and a manually adjustable element on one of the parts for moving that part relative to the other part to apply a selected degree of compression loading to the resilient means as aforesaid.

4. A shock absorber according to Claim 1 wherein the presetting means comprise an abutment on each of said two relatively movable parts between which the resilient means act, the abutment on one part being provided by a movable element on that part, the position of the element being adjustable to allow the setting of a required amount of initial compression of the resilient means.

5. A shock absorber according to Claim 3 wherein said element is a screw-threaded element located on a screw-threaded portion of the part with which it is associated.

6. A shock absorber according to Claim 1 wherein the indicator means comprise an element gripped between opposed portions of said parts until the tension load applied to the device reaches the preset tension load of the device, when the element is then released to indicate that the preset tension load has been reached.

7. A shock absorber according to Claim 1 wherein said indicator means include a plastically deformable element arranged to be compressed on said relative movement of said parts whereby the element is permanently deformed to give a visual indication that a shock load has been applied to the safety line.

8. A shock absorber according to Claim 1 wherein two sets of said relatively movable parts are provided and one part of each set is provided by discrete portions of a body member of the shock absorber.

9. A shock absorber according to Claim 8 wherein the body member is elongate with one relatively movable part slidably engaged with each opposite end portion of the body member.

10. A shock absorber according to Claim 9 wherein said one relatively movable part at each end of the body member comprises a tubular first member slidably, but

non-rotatably mounted with respect to the body member, and a second member screw-threadably received within the first member, the screw-threads of the parts of first and second members at respective opposite ends of the body member being of the opposite hand, whereby initial tensioning of the line can be achieved by rotating said body member about its longitudinal axis.

11. A turnbuckle incorporating tension load indicating means, comprising an elongate, tubular body member, and, at each end thereof, a tubular first member slidably, but non-rotatably, mounted on the body member, a second member screw-threadably received within said first member, resilient means acting between said first member and the body member to oppose relative movement thereof in one direction when a tension loading is applied across the turnbuckle, adjustable setting means for applying an initial selected degree of compression loading to the resilient means for pre-setting the tension load required to be applied to the turnbuckle to effect relative movement of said first member and said body part in said one direction, and indicator means responsive to said relative movement to provide an indication of when tension loading applied to the turnbuckle, in use, reaches said preset tension load, wherein the screw-threads of the pairs of said first and second members at respective opposite ends of the body member are of the opposite hand whereby tensioning of a line associated with the turnbuckle can be achieved by rotating said body member about its longitudinal axis.

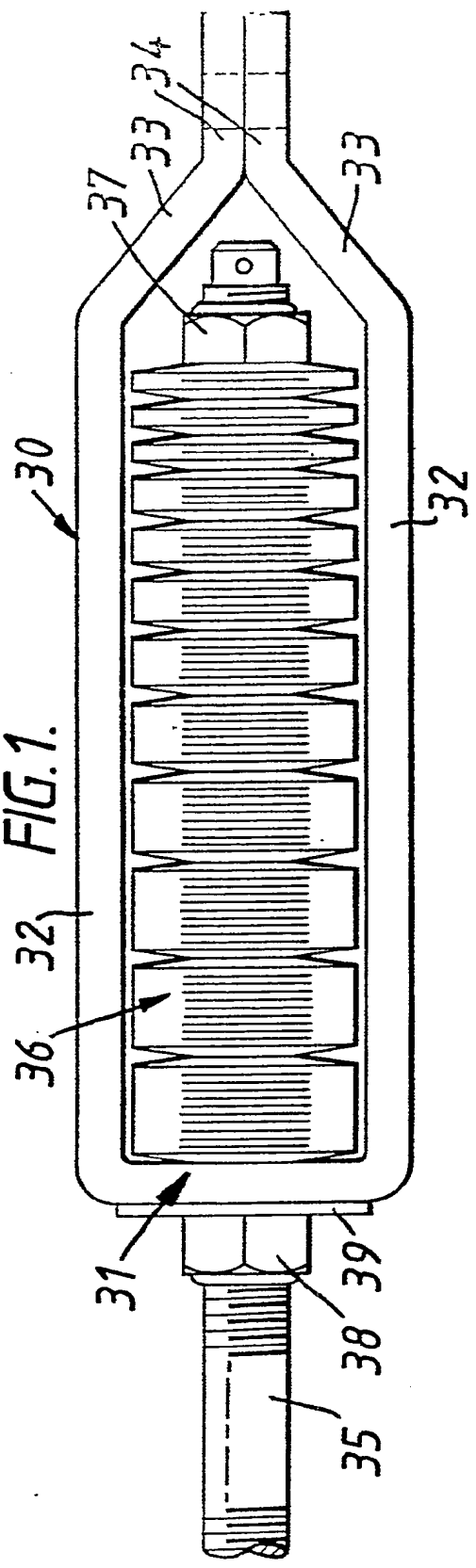

FIG.1.

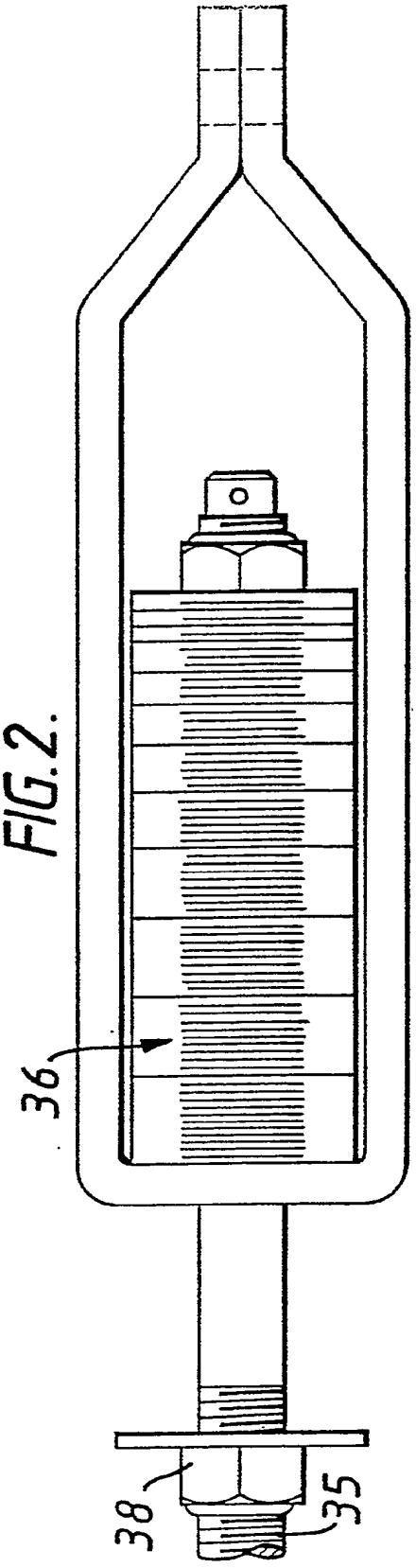

FIG.2.

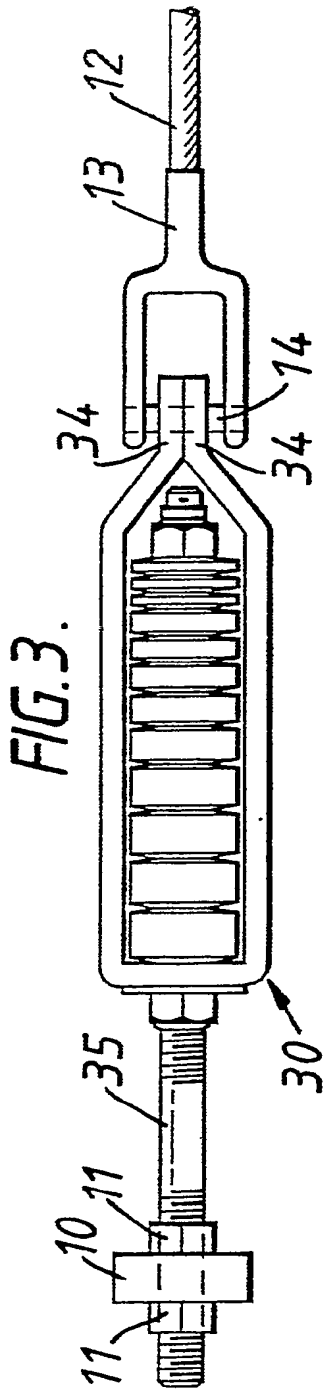

FIG.3.

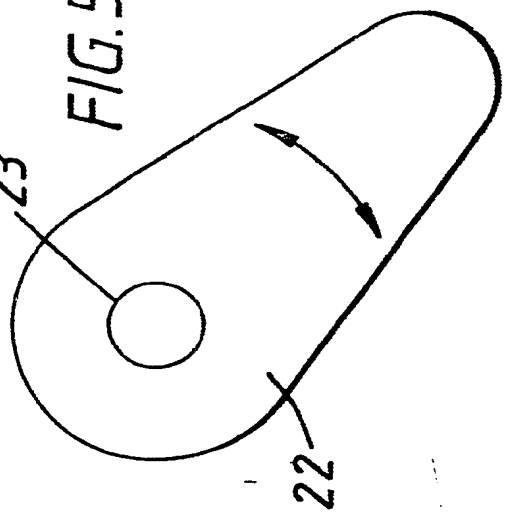

FIG.5.

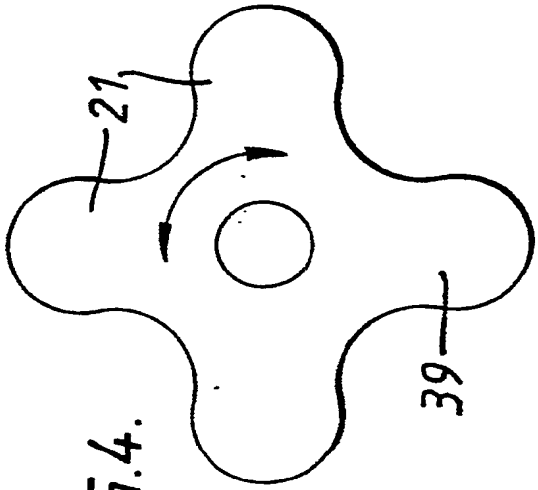

FIG.4.

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Fig. 6.

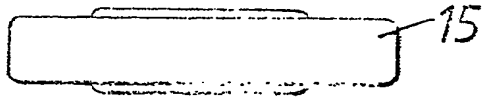


FIG. 7.

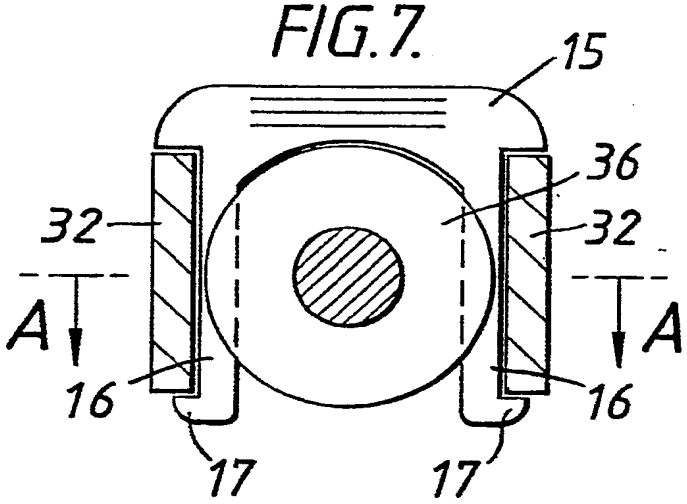
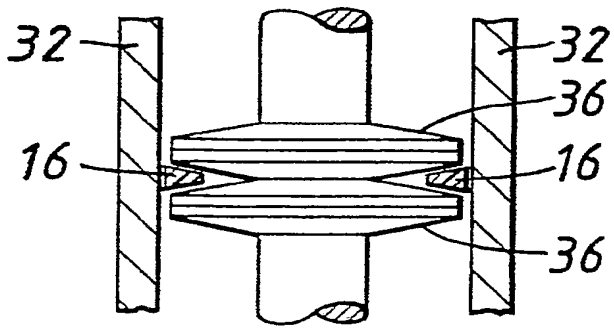


FIG. 8.



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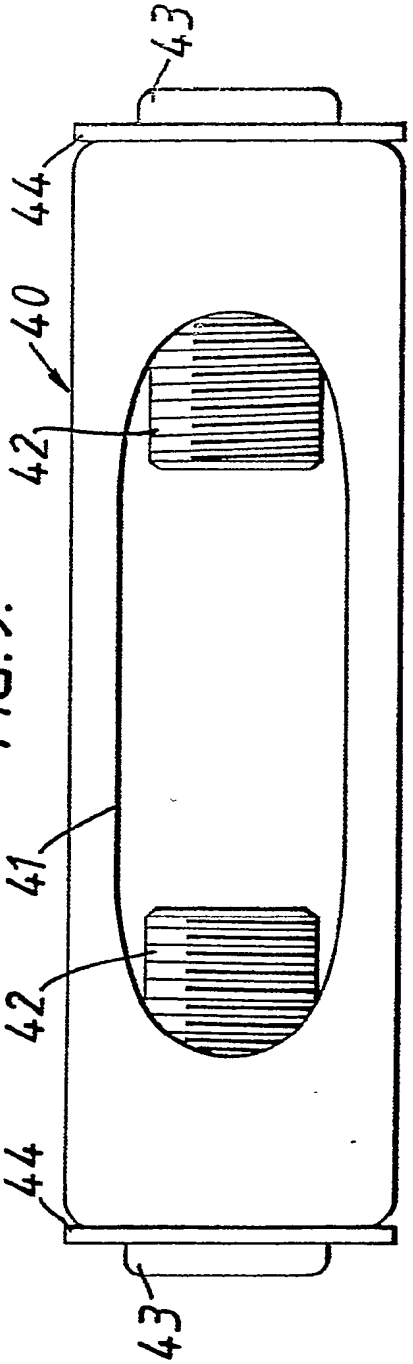

FIG. 9.

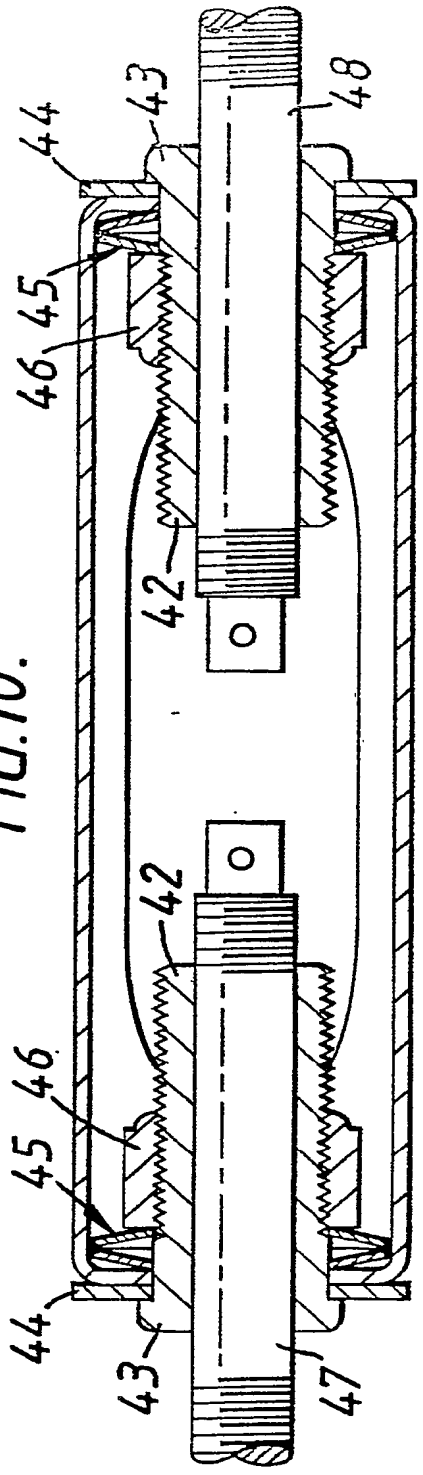

FIG. 10.

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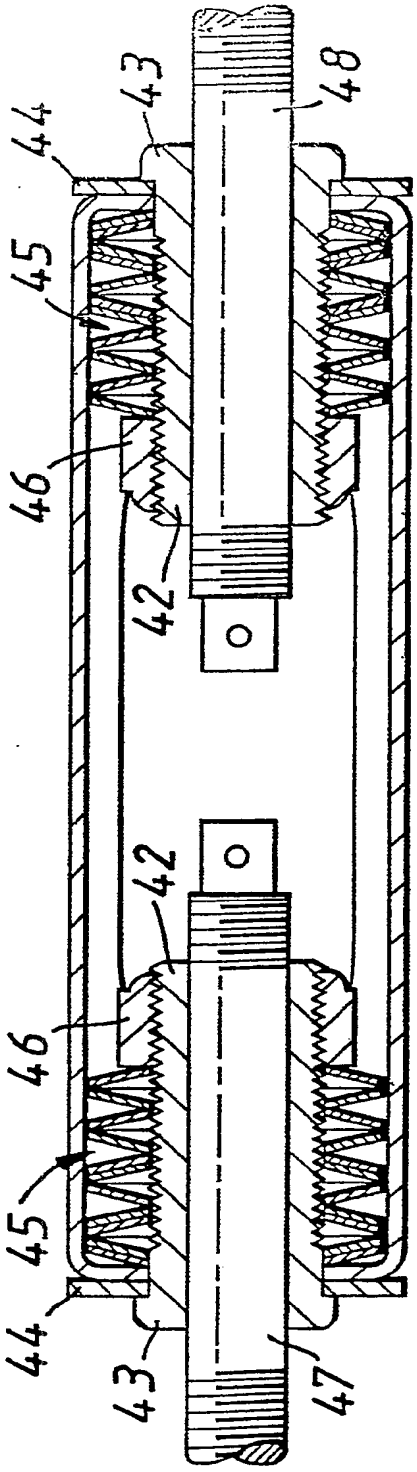

FIG.11.

European Patent Office

EUROPEAN SEARCH REPORT

0212826
Application number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 86305303.9

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	DE - A1 - 2 855 989 (EISEN- UND DRAHTWERK ERLEN AG) * Totality * --	1-5, 11	G 01 L 5/06 F 16 G 11/12
A	DE - A1 - 3 244 189 (DAIMLER-BENZ AG) * Fig. 1,2 * --	1,2,3, 4,5,11	
A	US - A - 2 570 321 (CHRISTOFFER) * Totality * --	1,3,4, 11	
A	US - A - 4 432 246 (GRANAT) * Fig. 1 * --	1-5	
D,A	US - A - 3 918 301 (BAER) * Fig. 1 * --	1,2	TECHNICAL FIELDS SEARCHED (Int. Cl.4) G 01 L 5/00 G 01 L 1/00
D,A	US - A - 3 033 154 (WEISEL) * Fig. 1 * --	1,2,3, 4	
A	GB - A - 1 452 705 (RUD-KETTEN-FABRIK RIEGER & DIETZ) * Fig. 3 * ----	7	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	30-10-1986	PIRKER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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